Numerical Model Simulations of Nitrate Concentrations in Groundwater Using Three Nitrogen Input Scenarios, Mid-Snake Region, South-Central Idaho

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As part of the U.S. Geological Survey's NAWQA program, nitrate transport in groundwater was modeled in the mid-Snake River region in south-central Idaho to project future concentrations of nitrate. A sub-regional groundwater model simulated the change of nitrate concentrations in groundwater over time in response to three nitrogen input scenarios: (1) nitrogen input fixed at 2008 levels; (2) nitrogen input increased from 2008 to 2028 using the same rate of increase as the average rate of increase during the previous 10 years (1998 through 2008); after 2028, nitrogen input is fixed at 2028 levels; and (3) nitrogen input related to agriculture completely halted, with only nitrogen input from precipitation remaining. Scenarios 1 and 2 project that nitrate concentrations in groundwater continue to increase from 10 to 50 years beyond the year nitrogen input is fixed, depending on the location in the model area. Projected nitrate concentrations in groundwater increase by as much as 2–4 milligrams per liter in many areas, with nitrate concentrations in some areas reaching 10 milligrams per liter. Scenario 3, although unrealistic, estimates how long (20–50 years) it would take nitrate in groundwater to return to background concentrations—the "flushing time" of the system. The amount of nitrate concentration increase cannot be explained solely by differences in nitrogen input; in fact, some areas with the highest amount of nitrogen input have the lowest increase in nitrate concentration. The geometry of the aquifer and the pattern of regional groundwater flow through the aquifer greatly influence nitrate concentrations. The aquifer thins toward discharge areas along the Snake River which forces upward convergence of good-quality regional groundwater that mixes with the nitrate-laden groundwater in the uppermost parts of the aquifer, which results in lowered nitrate concentrations.